3.2 NOISE

3.2.1 Regulatory Background and Coordination

3.2.1.1 Characteristics of Sound

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern (USEPA, 1974). Magnitude measures the physical sound energy in the air. The range of magnitude from the faintest to the loudest sound the ear can hear is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness, compared to physical sound measurement, refers to how people subjectively judge a sound and varies from person to person. Magnitudes of typical sound levels are presented in Table 3.2-1.

Table 3.2-1: Typical Sound Levels

Transportation Sources	Sound Level (dBA)	Other Sources	Description
	130		Painfully loud
Jet takeoff (200 feet)	120		
Car horn (3 feet)			
	110	Maximum vocal effort	
	100	Shout (0.5 feet)	
			Very annoying
Heavy truck (50 feet)	90	Jack hammer (50 feet)	Loss of hearing with
		Home shop tools (3 feet)	prolonged exposure
Train on a structure (50 feet)	85	Backhoe (50 feet)	
City bus (50 feet)	80	Bulldozer (50 feet)	Annoying
		Vacuum cleaner (3 feet)	
Train (50 feet)	75	Blender (3 feet)	
City bus at stop (50 feet)			
Freeway traffic (50 feet)	70	Lawn mower (50 feet)	
		Large office	
Train in station (50 feet)	65	Washing machine (3 feet)	Intrusive
	60	TV (10 feet)	
Light traffic (50 feet)		Talking (10 feet)	
Light traffic (100 feet)	50		Quiet
		Refrigerator (3 feet)	
	40	Library	
	30	Soft whisper (15 feet)	Very quiet

Sources: FTA, 1995; USEPA, 1971; USEPA, 1974

Humans respond to a sound's frequency or pitch. The human ear is very effective at perceiving sounds with a frequency between approximately 1,000 and 5,000 hertz (Hz), with the efficiency decreasing outside this range. Environmental sound is composed of many frequencies, each occurring simultaneously at its own sound pressure level. Frequency weighting, which is applied electronically by a sound level meter, combines the overall sound frequency into one sound level that simulates how an average person hears sounds. The commonly used frequency weighting for environmental sound is A-weighting (dBA), which is most similar to how humans perceive sounds of low to moderate magnitude.

Because of the logarithmic decibel scale, a doubling of the number of sound sources, such as the number of cars operating on a roadway, increases sound levels by 3 dBA. A tenfold increase in the number of sound sources will add 10 dBA. As a result, a sound source emitting a sound level of 60 dBA combined with another sound source of 60 dBA yields a combined sound level of 63 dBA, not 120 dBA. The human ear can barely perceive a 3 dBA increase, while a 5 or 6 dBA increase is readily noticeable and sounds as if the sound is about one and one-half times as loud. A 10 dBA increase appears to be a doubling in sound level to most listeners.

Noise levels from traffic sources depend on volume, speed, and the type of vehicle. Generally, an increase in volume, speed, or vehicle size increases traffic noise levels. Vehicular noise is a combination of noises from the engine, exhaust, and tires. Other conditions affecting traffic noise include defective mufflers, steep grades, terrain, vegetation, distance from the roadway, and shielding by barriers and buildings.

Sound levels decrease with distance from the sound source. For a line source such as a roadway, sound levels decrease 3 dBA over hard ground (concrete, pavement) or 4.5 dBA over soft ground (grass) for every doubling of distance between the source and the receptor (the individual hearing the sound). For a point source such as a piece of construction equipment, sound levels decrease between 6 and 7.5 dBA for every doubling of distance from the source.

The propagation of sound can be greatly affected by terrain and the elevation of the receiver relative to the sound source. Level ground is the simplest case. Sound travels in a straight line-of-sight path between the source and the receiver. The addition of a berm or other area of high terrain would reduce the sound energy arriving at the receiver. Breaking the line of sight between the receiver and the highest sound source results in a sound reduction of approximately 5 dBA.

If the sound source is lowered or the receiver is elevated, sound generally would travel directly to the receiver. In some situations, sound levels may be reduced because the terrain crests between the source and receiver, resulting in a partial noise barrier near the receiver. If the sound source is elevated or the receiver is lowered, sound may be reduced at the receiver, because the edge of the roadway can act as a partial noise barrier, blocking some sound transmission between the source and receiver.

3.2.1.2 Sound Level Descriptors

A widely used descriptor for environmental noise is the equivalent sound level (L_{eq}). The L_{eq} can be considered a measure of the average sound level during a specified period of time. It is a measure of total sound, or a summation of all sounds during a time period, and places more emphasis on occasional high sound levels that accompany general background sound levels. L_{eq} is defined as the constant level that, over a given period of time, transmits to the receiver the same amount of acoustical energy as the actual time-varying sound. For example, two sounds, one of which contains twice as much energy but lasts only half as long, have the same L_{eq} sound levels. L_{eq} measured over a one-hour period is the hourly L_{eq} [L_{eq}(h)], which is used for highway noise impact and abatement analyses. The day/night level (L_{dn}), a daily averaged sound level that ranks sound that occurs during the evening or night more heavily, is often reported. The L_{dn} adds 10 dBA to sound levels that occur between 10 p.m. and 7 a.m. L_{dn} is used for transit noise impact and abatement analyses to residential areas.

Short-term noise levels, such as those from a single truck pass-by, can be described by the highest instantaneous noise level that occurs during the event. The maximum sound level (L_{max}) is the greatest short-duration sound level that occurs during a single event. L_{max} is related to impacts on speech interference and sleep disruption. In comparison, L_{min} is the minimum sound level during a period of time.

3.2.1.3 Effects of Noise

Environmental noise at high intensities directly affects human health by causing hearing loss. Although scientific evidence currently is not conclusive, noise is suspected of causing or aggravating other diseases. Environmental noise indirectly affects human welfare by interfering with sleep, thought, and conversation. The FHWA noise abatement criteria are based on speech interference, which is a well-documented impact that is relatively reproducible in human response studies.

3.2.1.4 Noise Regulations and Impact Criteria

Applicable noise regulations and guidelines provide a basis for evaluating potential noise impacts. The I-405 Corridor Program has components falling in different jurisdictions. FHWA guidelines are applicable to the proposed roadway components, FTA criteria apply to transit components, and local codes regulate construction noise.

For federally funded highway projects, traffic noise impacts are defined to occur when predicted L_{eq}(h) noise levels approach or exceed noise abatement criteria (NAC) as established by the FHWA, or substantially exceed existing noise levels (U.S. Department of Transportation, 1982, Noise Abatement Council). Although "substantially exceed" is not defined, WSDOT considers an increase of 10 dBA or more to be a substantial increase.

The FHWA noise abatement criteria specify exterior L_{eq}(h) noise levels for various land activity categories (Table 3.2-2). For receptors where serenity and quiet are of extraordinary significance, the noise criterion is 57 dBA. For residences, parks, schools, churches, and similar areas, the noise criterion is 67 dBA. For other developed lands, the noise criterion is 72 dBA. WSDOT considers a noise impact to occur if predicted L_{eq}(h) noise levels approach within 1 dBA of the noise abatement criteria in Table 3.2-2. Thus, if a noise level were 66 dBA or higher, it would approach or exceed the FHWA noise abatement criterion of 67 dBA for residences.

Table 3.2-2: FHWA Noise Abatement Criteria

Activity Category	L_{eq} (h) (dBA)	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: U.S. Department of Transportation, 1982.

For federally funded transit projects the FTA has established impact criteria. Under the FTA criteria, noise impacts occur when predicted L_{eq}(h) or L_{dn} noise levels caused by a project increase the overall noise by between 1 and 10 dBA, depending on the land use and existing noise level (FTA, 1995). In general, the higher the existing noise level, the less a project may increase the overall noise level without causing a noise impact under the FTA criteria. There are three categories of sensitive land use (Table 3.2-3), which may be impacted by noise. Other uses, such as retail and industrial, are generally not noise-sensitive.

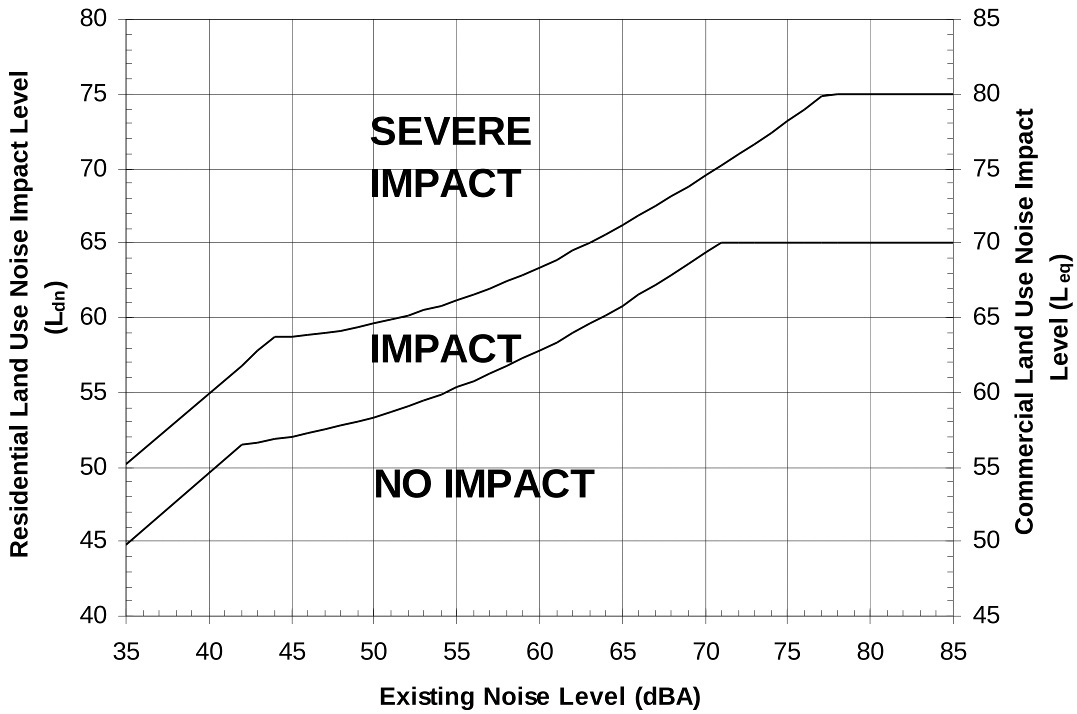
Table 3.2-3: FTA Noise-Sensitive Land Uses

Category	Description of Activity Category
1	The most sensitive land uses. It includes land where quiet is essential, such as outdoor amphitheaters and concert pavilions.
2	Places where people sleep, including homes, apartments, hotels, and hospitals.
3	The least sensitive of the three, includes schools, libraries, medical offices, concert halls, and other similar uses.

Source: FTA, 1995

The project noise exposure levels that define impacts from transit facilities under the FTA criteria are presented in Figure 3.2-1. The noise exposure levels shown in Figure 3.2-1 include only noise generated by the project and not other noise sources that contribute to the overall noise level in the project area. For example, if a project is located in a residential area with an average L_{dn} of 50 dBA, the project can generate up to 54 dBA L_{dn} without causing any impact and up to 59 dBA L_{dn} without causing a severe impact. For noise-sensitive commercial areas, impacts are determined by peak-hour L_{eq}, so if the average L_{eq} is 50 dBA, the project can generate up to 59 dBA L_{eq} without causing any impact and up to 64 dBA L_{eq} without causing a severe impact. Severe impacts generally meet the definition of a significant adverse impact under the National Environmental Policy Act (NEPA).

Figure 3.2-1: FTA Noise Exposure Impact Criteria for Transit Facilities



Washington State Department of Ecology limits noise levels at property lines of neighboring properties (WAC Chapter 173-60). The maximum permissible noise levels depend on the land uses of both the source noise and receiving property (Table 3.2-4). The environmental designation for noise abatement (EDNA) is defined by the land use of a property. In general, residential uses are class A, commercial are class B, and industrial are class C.

Table 3.2-4: Maximum Permissible Environmental Noise Levels

	EDNA of Receiving Property		
EDNA of Noise Source	**Class A**	**Class B**	**Class C**
CLASS A	55 dBA	57 dBA	60 dBA
CLASS B	57	60	65
CLASS C	60	65	70

Source: WAC 173-60-030

Short-term exceedances above the permissible sound level are allowed. The maximum level may be exceeded by 5 dBA for a total of 15 minutes, by 10 dBA for a total of 5 minutes, or by 15 dBA for a total of 1.5 minutes during any one-hour period (WAC 173-60-040). These allowed exceptions are referred to in terms of the percentage of time a certain level is exceeded; an L_{25} is the noise level that is exceeded 15 minutes during an hour. Therefore, the permissible L_{25} would be 5 dBA greater than the values in Table 3.2-4, provided that the noise level is below the permissible level in Table 3.2-4 for the rest of the hour and never exceeds the permissible level by more than 5 dBA. An hourly L_{eq} of approximately 2 dBA higher than the values in Table 3.2-4 is an equivalent sound level to the permissible levels, including the allowed short-term increases. Using this rule, an L_{eq}(h) of 59 dBA corresponds approximately to a noise level of 57 dBA for 45 minutes and 62 dBA for 15 minutes, which is the maximum permissible noise level created by a commercial source and received by a residential property. Both King and Snohomish counties and many cities have adopted the Ecology standards with minor differences.

Construction noise from the project, however, must meet Ecology property line regulations. Construction noise is exempt from property line standards during daytime hours. Noise levels in Table 3.2-4 apply to construction equipment only at rural and residential receiving properties between 10 p.m. and 7 a.m.

3.2.1.5 Coordination with Agencies and Jurisdictions

The methodology and process used for this analysis were discussed with WSDOT, USEPA, and Sound Transit on August 16, 2000. Sound Transit provided monitoring data from the Totem Lake Park-and-Ride environmental studies.

3.2.2 Methodology

Ambient noise levels were measured to describe the existing noise environment and identify major noise sources in the affected area. Ambient noise levels were measured at 35 locations in the affected area to characterize the weekday noise levels. At most locations, 15-minute measurements were taken to estimate the L_{eq}(h). At four locations near major transit noise sources, 24 1-hour measurements were taken to determine the daily noise profile. Measurement locations represent a variety of noise conditions and are representative of other sensitive receptors near the proposed improvements.

L_{eq}(h) traffic noise levels at representative locations in the corridor were predicted using FHWA's STAMINA 2.0 computer model. For the high-capacity transit components of Alternatives 1 and 2, noise exposure levels, the quantity of noise caused by the project that would result from each of the alternatives, were modeled using FTANOISE, the FTA Transit Noise Assessment Spreadsheet Model (HMMH, 1995), near transit noise sources. FTA noise impacts consider the entire noise environment, while FHWA noise impacts are traffic noise only. For the traffic noise impact areas, noise from fixed-guideway high-capacity transit was not considered in the impact calculation, but bus traffic traveling on I-405 was included. For the high-capacity transit noise impacts, traffic noise was factored into the background noise level when calculating the impact distance.

In most cases where the roadway and fixed-guideway high-capacity alignments are in close proximity, the traffic noise impact is greater than the transit noise impact, and the traffic noise impact area includes the impact area of both sources. Generalized traffic noise contours of 66 dBA and transit noise contours that varied by existing background noise levels per Figure 3.2-1 were created using the modeled noise levels.

At the level of analysis available for this corridor study, terrain features and existing noise barriers are not included in the noise contour calculations; therefore, these noise contours define the potential for noise impact, rather than the area adversely affected by noise. The contours were input to the GIS system, and the parcels within the contour were calculated. These parcels were compared to the King County Department of Assessments Residential Parcel File to determine which parcels included residential land use. All parcels within the potential impact contour that include residential uses were counted. The reported number of affected properties overestimates the actual number that would be affected by each of the alternatives because local shielding features were neglected. The same methodology was used for each alternative; therefore, the level of impact can be compared validly among the alternatives.

The noise analyses in this section are based on the *I-405 Corridor Program Draft Noise Expertise Report* (Parsons Brinckerhoff, 2001), herein incorporated by reference.

3.2.3 Affected Environment

3.2.3.1 Land Use

Land use varies along the approximately 30-mile length of the I-405 corridor. Most of the corridor lies in urban and suburban areas with residential, commercial, and industrial noise sources bordering the corridor.

3.2.3.2 Existing Noise Levels

Noise measurements were completed throughout the I-405 corridor. At three locations, 24-hour noise measurements were taken (Locations A, B, and D on Table 3.2-5). In the Totem Lake area, 24-hour data were provided from Sound Transit's Park-and-Ride Study (Entech Northwest, 2000) (Location C on Table 3.2-5). Short-duration noise levels were measured at 31 locations in the corridor to further characterize the noise environment (Table 3.2-6).

Table 3.2-5: 24-Hour Noise Measurements

Location	Max L_{eq}(h) (dBA)	L_{dn} (dBA)
A Gene Coulon Park, Renton	60	56
B Terrace Park, Kirkland	62	61
C Totem Lake P&R	65	68
D Hawthorn Subdivision, Woodinville	62	60

The potential noise impact area along I-405 was calculated using existing peak-hour noise volumes (Table 3.2-7). This area assumes level terrain and no noise barriers or other shielding in order to describe the potential for noise impact under each alternative. The actual area affected by traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria would be less than the area calculated because the calculations make several simplifying assumptions. This methodology was also used to calculate the receptors that would be affected in the future; therefore, these values provide a baseline to compare areas potentially impacted in the future to those within the current potential impact area. Under existing conditions, 1,396 residential parcels are within the potential traffic noise impact area.

Table 3.2-6: 15-Minute Noise Measurements

Location		Date	Start Time	L_{eq} (dBA)	L_{max} (dBA)
1	Tukwila Park, Tukwila	10/12/00	9:00 a.m.	63	77
2	S 14th St & Whitworth, Renton	10/12/00	9:45 a.m.	70	78
3	819 S 5th, Renton	10/12/00	11:55 a.m.	62	76
4	Mill Ave & S. 4th, Renton	10/12/00	11:30 a.m.	63	79
5	582 Bronson, Renton	10/12/00	11:00 a.m.	65	76
6	High Ave N & NE 24th, Renton	10/17/00	12:10 p.m.	66	74
7	3940 Meadow Ave N, Renton	6/13/00	2:15 p.m.	68	71
8	Nautica Apartments, Newcastle	5/11/00	5:05 p.m.	66	72
9	11007 SE 60th	10/17/00	11:35 a.m.	62	68
10	4964 116th Pl.	10/17/00	11:10 a.m.	61	67
11	4605 Bagley Ln.	10/17/00	12:40 p.m.	65	71
12	12203 SE 35th	10/17/00	10:40 a.m.	69	74
13	1401 121st Ave, Bellevue	11/10/00	2:25 p.m.	63	70
14	1750 112th Ave, Bellevue	11/14/00	4:30 p.m.	66	72
15	Boulders at Pikes Peak Sub.	11/10/00	3:10 p.m.	63	71
16	The Little School on 116th, Bellevue	11/10/00	3:45 p.m.	67	72
17	6512 114th Ave NE	11/14/00	3:25 p.m.	65	69
18	7616 116th Ave	10/24/00	4:45 p.m.	66	75
19	11652 95th St	10/17/00	3:45 p.m.	65	71
20	12105 NE 108th	10/17/00	3:15 p.m.	69	73
21	116th and NE 128th	10/17/00	2:45 p.m.	64	69
22	Kingsgate Park	10/17/00	2:10 p.m.	61	72
23	14504 NE 145th	10/24/00	3:25 p.m.	63	73
24	11601 NE 159th St	10/24/00	2:55 p.m.	60	71
25	Apt at 115th NE and NE 160th	10/24/00	2:10 p.m.	65	78
26	112th and NE 197thSt.	10/24/00	1:30 p.m.	63	70
27	233rd Pl and 25th Pl	10/24/00	12:50 p.m.	60	69
28	21729 4th Ave SE	10/24/00	4:10 p.m.	67	79
29	21431 Royal Ann	10/24/00	10:40 a.m.	64	72
30	20113 S Danvers	10/24/00	11:05 a.m.	68	77
31	1110 Kentish	10/24/00	11:35 a.m.	58	66

Table 3.2-7: Existing Potential Noise Impact Areas

Location on I-405 Corridor (between)		Distance (feet) from I-405 Centerline	Number of Residential Parcels
I-5 (Tukwila)	SR 167	325	6
SR 167	SR 169	400	84
SR 169	NE 44th	350	203
NE 44th	NE 8th (Belv.)	450	449
NE 8th (Belv.)	NE 85th	425	210
NE 85th	NE 124th	425	153
NE 124th	SR 522	475	289
SR 522	NE 195th	325	None
NE 195th	SR 527	325	2
		Total potentially affected parcels	1,396

3.2.4 Impacts

3.2.4.1 No Action Alternative

Construction Impacts

The No Action Alternative includes construction of baseline projects outlined in Section 2.2.1 of this report. These construction activities would generate noise independent of the I-405 Corridor Program and would be addressed through the environmental analysis, documentation, and review completed for those projects.

Operational Impacts

Using the same methodology as for existing conditions, the potential noise impact area along I-405 was calculated (Table 3.2-8). The calculation of this area assumed level terrain and no noise barriers or other shielding in order to describe the potential for noise impact under each alternative. The actual area affected by traffic noise levels that approach or exceed the FHWA Noise Abatement Criteria would be less than the calculated area because the calculations make several simplifying assumptions; therefore, this area represents potential for noise impacts, rather than the area adversely affected by noise. The number of residential parcels was calculated within the noise potential area (Table 3.2-9). For the length of the I-405 corridor, there are 1,729 residential properties within the potential impact area under the No Action Alternative in 2020. This figure represents a 24 percent increase in the number of potentially noise-affected residential parcels relative to existing conditions in the I-405 corridor.

3.2.4.2 Alternative 1: HCT/TDM Emphasis

Construction Impacts

Construction activities would generate noise during the construction period. Construction usually would be carried out in several reasonably discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. Roadway construction would involve clearing, cut-and-fill activities, removing old roadways, importing fill, and paving. Rail construction in the high-capacity transit corridor would include similar activities, such as removal of old rail and ties, placement of ballast, construction of structures, and laying new rail.

Table 3.2-8: Year 2020 Potential Traffic Noise Impact Areas Along I-405

Location on I-405 Corridor (between)		Distance (feet) from I-405 Centerline: No Action	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Preferred Alternative
I-5	SR 167	350	350	450	525	525	525
SR 167	SR 169	425	425	525	600	650	650
SR 169	NE 44th	400	400	475	525	600	600
NE 44th	NE 8th (Belv)	475	475	525	600	650	650
NE 8th (Belv)	NE 85th	450	450	525	525	600	600
NE 85th	NE 124th	475	475	525	600	650	650
NE 124th	SR 522	525	525	600	725	725	725
SR 522	NE 195th	350	350	425	475	475	475
NE 195th	SR 527	350	350	425	475	475	475
SR 527	I-5	450	450	475	475	475	475

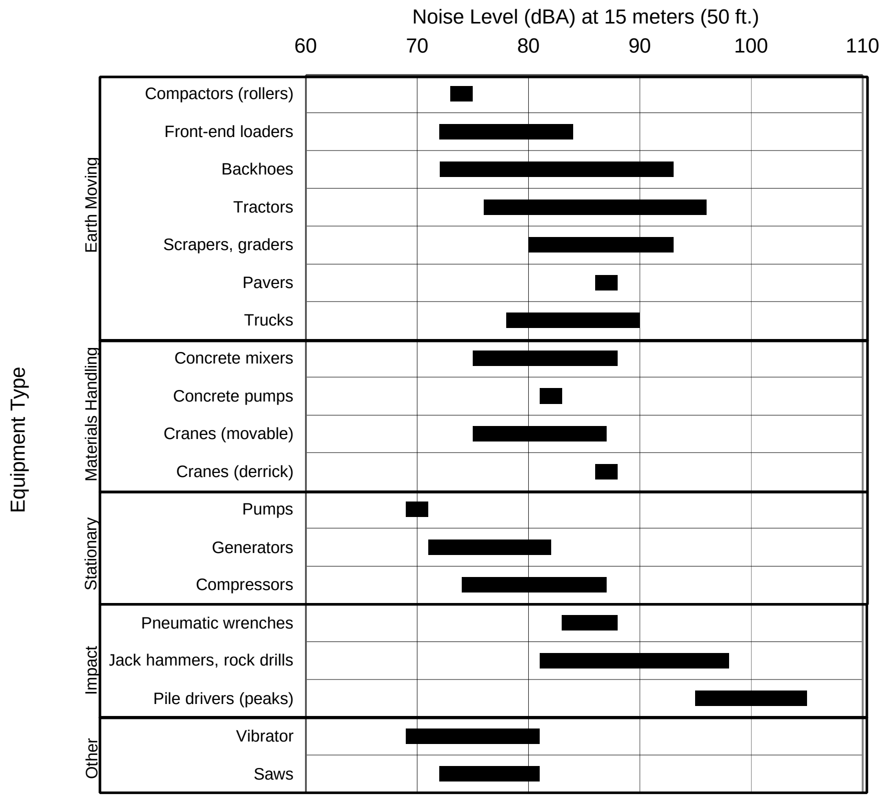
Table 3.2-9: Year 2020 Residential Parcels within Potential Traffic Noise Impact Areas

Location on I-405 Corridor (between)		Number of Parcels: No Action	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Preferred Alternative
I-5	SR 167	14	14	15	19	19	19
SR 167	SR 169	92	92	163	192	141	141
SR 169	NE 44th	265	265	316	357	420	420
NE 44th	NE 8th (Belv)	493	493	573	667	725	725
NE 8th (Belv)	NE 85th	277	277	348	378	469	469
NE 85th	NE 124th	198	198	216	262	290	290
NE 124th	SR 522	328	328	416	549	549	549
SR 522	NE 195th	None	None	None	None	None	None
NE 195th	SR 527	62	62	62	62	62	62
Total potentially affected parcels		1,729	1,729	2,109	2,486	2,675	2,675

The most prevalent noise source at construction sites would be the internal combustion engine. Engine-powered equipment includes earth-moving equipment, material-handling equipment, and stationary equipment. Mobile equipment operates in a cyclic fashion, while stationary equipment, such as generators and compressors, operates at sound levels fairly constant over time. Because trucks would be present during most phases and would not be confined to the construction site, noise from trucks could affect additional receptors. Other noise sources would include impact equipment and tools such as pile drivers. Impact tools could be pneumatically powered, hydraulic, or electric.

Construction noise would be intermittent, occurring seasonally during an approximately two-year construction period. Construction noise levels would depend on the type, amount, and location of construction activities. The type of construction methods would establish the maximum noise levels of construction equipment used. The amount of construction activity would determine how often construction noise would occur throughout the day. The location of construction equipment relative to adjacent properties would determine any effects of distance in reducing construction noise levels. Maximum noise levels of construction equipment under all action alternatives would be similar to typical maximum construction equipment noise levels presented in Figure 3.2-2. As shown in Figure 3.2-2, maximum noise levels from construction equipment would range from 69 to 106 dBA at 50 feet (15 meters). Construction noise at residences farther away would decrease at a rate of 6 dBA per doubling of distance from the source. The number of occurrences of the L_{max} noise peaks would increase during construction, particularly during pile-driving activities. Because various equipment would be turned off, idling, or operating at less than full power at any time, and because construction machinery is typically used to complete short-term tasks at any given location, average L_{eq} noise levels during the day would be less than maximum noise levels presented in Figure 3.2-2.

Figure 3.2-2: Construction Noise Levels



Source: USEPA, 1971 and WSDOT, 1999

Construction noise is exempt from local property line regulations during daytime hours. Because of the nature of the proposed improvements to I-405, nighttime construction activities could be required in the corridor for many of the project elements. Any construction activities between 10 p.m. and 7 a.m. would either have to comply with local property line standards (Table 3.2-4) or would require a nighttime construction noise variance from the appropriate local jurisdiction. In addition, construction noise levels could be reduced by the construction practices identified in Section 3.2.5, Mitigation Measures.

Operational Impacts

The potential traffic noise impact area for Alternative 1 along I-405 is calculated in Table 3.2-8. Because Alternative 1 also would include a physically separated, fixed-guideway high-capacity transit component, the potential operational noise impact area for rail transit is also calculated for the HCT corridor (Table 3.2-10). The methodology used to assess transit noise closely followed that for traffic noise; however, the area of potential impact was determined based on the existing noise level in the area and the projected noise exposure, per FTA methodology.

Table 3.2-10: Year 2020 Potential HCT Noise Impact Areas

Location on HCT Corridor (between)		Distance (feet) from HCT Corridor Centerline		
		No Action	Alternative 1	Alternative 2
Tukwila	Renton CBD	None	50 to 110 [a]	50 to 110 [a]
Renton CBD	Factoria	None	75	75
Factoria	Issaquah	None	None	None
Factoria	Downtown Bellevue	None	110	110
Bellevue	Redmond	None	100	100
Bellevue	SR 520	None	75	75
SR 520	Totem Lake	None	75 to 110 [a]	75 to 110 [a]
Totem Lake	Bothell	None	None	None
Bothell	Lynnwood	None	None	None

[a] When a range is given, the lower number is for at-grade sections and the higher number for aerial sections.

The number of residential parcels was calculated within the noise potential areas for traffic and transit in Table 3.2-9 and Table 3.2-11 respectively. For the study area, there are 1,931 residential properties within the potential impact areas for traffic and transit noise under Alternative 1 in 2020. This figure represents a 12 percent increase in the number of residential parcels potentially affected by noise relative to the No Action Alternative, and a 38 percent increase relative to existing conditions.

Table 3.2-11: Year 2020 Residential Parcels within Potential HCT Noise Impact Areas

Location on HCT Corridor (between)		Number of Parcels		
		No Action	Alternative 1	Alternative 2
Tukwila	Renton CBD	None	25	25
Renton CBD	Factoria	None	41	41
Factoria	Issaquah	None	None	None
Factoria	Downtown Bellevue	None	2	2
Bellevue	Redmond	None	14	14
Bellevue	SR 520	None	5	5
SR 520	Totem Lake	None	105	105
Totem Lake	Bothell	None	None	None
Bothell	Lynnwood	None	None	None
Total potentially affected parcels		None	202	202

3.2.4.3 Alternative 2: Mixed Mode with HCT/Transit Emphasis

Construction Impacts

Construction impacts under Alternative 2 would be similar to Alternative 1. There would be slightly more construction noise associated with I-405 under Alternative 2 than Alternative 1.

Operational Impacts

The potential traffic noise impact area for Alternative 2 along I-405 is calculated in Table 3.2-8. Because Alternative 2 also would include a physically separated, fixed-guideway high-capacity transit component, the potential operational noise impact area for rail transit was also calculated for the HCT corridor (Table 3.2-10) using the FTA methodology.

The number of residential parcels was calculated within the noise potential areas for traffic and transit in Table 3.2-9 and Table 3.2-11, respectively. For the study area, there are 2,311 residential properties within the potential impact areas for traffic and transit noise under Alternative 2 in 2020. This figure represents a 34 percent increase in the number of residential parcels potentially affected by noise relative to the No Action Alternative and a 66 percent increase relative to existing conditions.

3.2.4.4 Alternative 3: Mixed Mode Emphasis

Construction Impacts

Construction impacts under Alternative 3 would be similar to Alternatives 1 and 2. There would be more construction noise associated with construction of additional roadway capacity in the I-405 corridor under Alternative 3 than Alternatives 1 and 2; however, there would be no fixed-guideway HCT construction.

Operational Impacts

The potential traffic noise impact area for Alternative 3 along I-405 is calculated in Table 3.2-8. Alternative 3 would not include a fixed-guideway high-capacity transit component; therefore, there would be no additional operational noise impacts in the BNSF alignment.

The number of residential parcels was calculated within the noise potential areas for traffic in Table 3.2-9. For the study area, there are 2,486 residential properties within the potential impact areas for traffic noise under Alternative 3 in 2020. This figure represents a 44 percent increase in the number of residential parcels potentially affected by traffic noise relative to the No Action Alternative and a 78 percent increase relative to existing conditions.

3.2.4.5 Alternative 4: General Capacity Emphasis

Construction Impacts

Construction impacts under Alternative 4 would be similar to those described for the other action alternatives. There would be more construction noise in the I-405 corridor under Alternative 4 than any of the other alternatives because of construction of the express roadway.

Operational Impacts

The potential traffic noise impact area for Alternative 4 along I-405 is calculated in Table 3.2-8. Alternative 4 would not include a fixed-guideway high-capacity transit component or BRT system; therefore, there would be no noise impacts associated with these systems.

The number of residential parcels was calculated within the noise potential areas for traffic in Table 3.2-9. For the study area, there are 2,675 residential properties within the potential impact areas for traffic noise under Alternative 4 in 2020. This figure represents a 55 percent increase in the number of residential parcels potentially affected by traffic noise relative to the No Action Alternative and a 92 percent increase relative to existing conditions.

3.2.4.6 Preferred Alternative

Construction Impacts

Construction impacts under the Preferred Alternative would be similar to those described for the other action alternatives. There would be more construction noise in the I-405 corridor under the Preferred Alternative than under Alternative 3, but less than under Alternative 4.

Operational Impacts

The potential traffic noise impact area for the Preferred Alternative along I-405 is presented in Table 3.2-8. The Preferred Alternative would be the same as Alternative 4 along much of the corridor. The Preferred Alternative would not include a fixed-guideway high-capacity transit component; therefore, there would be no noise impacts associated with this system.

The estimated number of residential parcels within the potential noise impact areas for traffic is shown in Table 3.2-9. For the study area, there are 2,675 residential properties within the potential impact areas for traffic noise under the Preferred Alternative in 2020 prior to application of mitigation measures. This figure represents a 55 percent increase in the number of residential parcels potentially affected by traffic noise relative to the No Action Alternative and a 92 percent increase relative to existing conditions, prior to application of existing and future mitigation.

3.2.5 Mitigation Measures

Noise can be controlled at three locations: (1) at the source, such as with mufflers and quieter engines; (2) along the noise path, with barriers; and (3) at the receptor, with insulation. Noise abatement is generally provided only where frequent human use occurs and where a lower noise level would have benefits.

Mitigation for the No Action Alternative projects would be addressed through the environmental analysis, documentation, and review completed for those projects. WSDOT has constructed noise barriers in portions of the I-405 corridor where capacity has been increased. In most locations the barriers were constructed in conjunction with construction of HOV lanes. WSDOT and/or co-lead agencies will continue to construct noise barriers in portions of the corridor not currently protected by barriers to reduce noise levels along the I-405 corridor per acceptable FHWA and FTA standards.

For all action alternatives, mitigation is discussed for potential to reduce the number of noise impacts under each alternative. Because this is a programmatic EIS with a general assessment of areas of potential impact, detailed mitigation analysis and recommendations are not included in this study. Project-level environmental analysis, documentation, and review will be conducted for individual improvements subsequent to the I-405 Corridor Program Final EIS.

3.2.5.1 Construction

Construction noise could be reduced by using enclosures or walls to surround noisy equipment, installing mufflers on engines, substituting quieter equipment or construction methods, minimizing time of operation, and locating equipment farther from sensitive receptors. To reduce construction noise at nearby receptors along the I-405 and fixed-guideway HCT corridors, the following mitigation measures could be incorporated into construction plans and contractor specifications:

- Erecting noise berms and barriers as early as possible would provide noise shielding.
- Limiting construction activities to between 7 a.m. and 10 p.m. would reduce construction noise levels during sensitive nighttime hours.
- Equipping construction equipment engines with adequate mufflers, intake silencers, and engine enclosures would reduce their noise by 5 to 10 dBA (USEPA, 1971).
- Specifying the quietest equipment available would reduce noise by 5 to 10 dBA.
- Turning off construction equipment during prolonged periods of nonuse would eliminate noise from construction equipment during those periods.
- Requiring contractors to maintain all equipment and train their equipment operators would reduce noise levels and increase efficiency of operation.
- Locating stationary equipment away from receiving properties would decrease noise from that equipment in relation to the increased distance.
- Constructing temporary noise barriers or curtains around stationary equipment that must be located close to residences would decrease noise levels at nearby sensitive receptors.

3.2.5.2 Operation

A variety of mitigation methods can be effective at reducing transportation noise impacts. For example, noise impacts from long-term operation of the improvements can be reduced by:

- Applying traffic management measures
- Acquiring land as buffer zones or for construction of noise barriers or berms
- Realigning the facility
- Installing noise insulation in public use or nonprofit institutional structures
- Constructing noise barriers or berms

These mitigation measures were evaluated for their potential to reduce noise impacts from the proposed action. Final determination of size and placement of noise barriers or berms and implementation of other mitigation methods takes place during detailed project design, after an opportunity for public involvement, and approval at the local, state, and federal levels.

Traffic management measures: These include time restrictions or traffic control devices and signing for prohibition of certain vehicle types (such as motorcycles and heavy trucks), modified speed limits, and exclusive land designations. Restriction of vehicle types and lower speed limits on I-405 could worsen congestion and is contrary to the purpose of the I-405 Corridor Program. Noise impacts could be reduced by land use controls throughout the study area; however, the area is largely built-out. A transportation system management plan to encourage the use of car pools and public transit would reduce vehicle trips and, subsequently, traffic noise. A 3 dBA decrease in traffic noise would require a reduction in traffic by approximately 50 percent.

Land acquisition for noise buffers or barriers: Much of the I-405 corridor is bordered by residential properties which would require relocation of residents and would be unreasonably expensive to acquire for the purpose of noise mitigation.

Realigning the facility: The horizontal alignment is defined by available right-of-way. During design, shifts in horizontal alignment would be considered to reduce noise exposure.

Noise insulation of buildings: Insulation of public and not-for-profit buildings may be feasible.

Noise barriers: These include noise walls, berms, and buildings that are not sensitive to noise. The effectiveness of a noise barrier is determined by its height and length and by the topography of the project site. To be effective, the barrier must block the "line of sight" between the highest point of a noise source, such as a truck's exhaust stack, and the highest part of a receiver. It must be long enough to prevent sounds from passing around the ends, have no openings such as driveway connections, and be dense enough so that noise would not be transmitted through it. Buildings that do not have noise sensitive uses also could function as barriers (U.S. DOT, 1973).

WSDOT typically evaluates many factors to determine whether barriers are feasible and reasonable. The evaluation includes engineering feasibility, i.e., whether barriers could be built in a location to achieve a noise reduction of at least 7 dBA at the closest receptors. Determination of reasonability includes the number of sensitive receptors benefited by at least 3 dBA, cost-effectiveness of the barriers, and concerns such as the desires of nearby residents, aesthetics, and safety. Mitigation costs to address the long-term noise impacts due to new transportation improvements will come from project dollars.

Currently, there are noise barriers along much of the I-405 corridor. WSDOT has been completing a Type I barrier program (retrofit program) for the corridor based on funding availability. Most of the corridor, starting from the south, is now complete. Completion of barriers, to address existing noise impacts along I-405 in areas that are reasonable and feasible is dependent on funding being provided by the state legislature. Those barriers would continue to reduce noise levels along I-405 relative to the noise levels projected in this report.

Because there are very few areas along I-405 that would meet reasonableness and feasibility criteria that would not already have barriers completed, it is expected that few if any new barriers would be required along I-405 as part of the I-405 Corridor Program. Barriers may prove reasonable along parts of the high-capacity transit corridor. Once detailed design information is available during the design of individual project elements, the need to increase the length or height of existing barriers, or construct new barriers would be determined during the detailed analysis of the individual project elements.